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**Proposal for a Simple Method to Determine Inverter Efficiency for the CEC
Emerging Renewables Program**

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Since the beginning of the CEC Emerging Renewables Program, inverter manufacturers have been required to submit an efficiency value for each inverter listed on the CEC List of Eligible Inverters. This efficiency number is used to determine the amount of rebate a customer receives based upon the product of the total cost of their renewable energy system and the inverter efficiency value. There has never been a standard by which to determine this value. It has been left to the manufacturer to supply any value they deemed appropriate. The CEC does not require test data or justification for the efficiency value provided by the manufacturer. Unfortunately, efficiency values are highly dependent on the test method and equipment used to perform the testing.

Inaccurate efficiency values can amount to a large impact to the amount of the renewable system rebate. Just 1-2% difference in efficiencies can amount to a rebate difference greater than the cost of the inverter. This provides for a severe competitive advantage between inverters. Under the existing CEC program requirements, an inverter that is highly efficient may often be listed at a lower efficiency compared to another inverter that did not use same test method, or is embellishing their results.

SMA America has been in recent discussions with the staff members of the CEC to "level the competitive playing field" for inverter efficiency values. Below is a proposed method for determining inverter efficiency that is simple, inexpensive, and will accurately provide a result indicative of actual system performance.

We recommend that the test be performed by a Nationally Recognized Testing Laboratory (NRTL). This procedure should take less than one hour of time and can be performed during product compliance testing. It may not provide an exact weighted efficiency value, but it will be accurate to within a few tenths of a percent. The important point is that all inverters will be tested to the same procedure, keeping the results similar for all products.

Procedure:

- 1) Ambient air temperature shall be 25C +/-5C (This follows current UL requirements).



- 2) Any external equipment power equipment required for normal operation shall be included in the testing (isolation transformers, external EMI/EMC filtering, etc).
- 3) Verify AC line voltage is within 2% of then nominal voltage rating at the terminals of the Equipment Under Test (EUT)
- 4) Set the DC supply to operate at the manufacturers stated EUT nominal DC input voltage +/-5%. If no voltage is specified, choose the midpoint of the DC operating voltage window. (This allows the manufacturer to choose the input voltage that is ideal for their design and topology. There may be some discussion here by the purists, but this is common practice in many industries when determining efficiency/economy ratings. Trying to measure and average multiple curves throughout the input voltage range will lead to months of debate and research.)
- 5) Operate the EUT at rated power for 30 minutes. (This allows the temperature of the power components to come up to normal operating temperatures, efficiency numbers will look much better within the first few minutes of operation when the EUT is cold.)
- 6) Operate the EUT from 10-100%, in 10% increments, and at 75% of the EUT full power rating.
- 7) Measure efficiency (output power divided by input power) 5 times at each power level. (The measuring equipment must be capable of automatically measuring instantaneous voltage and current of the input and output circuits, minimum wide bandwidth, true RMS metering, calibrated)
- 8) Average the data at each measuring interval to generate the power curve.

SMA America will offer to host any efficiency measurements using our calibrated test equipment in the presence of 3rd-party testing lab (NRTL) personnel. We also offer to host a demonstration meeting at our facility in Grass Valley for CEC staff and contractors.

Sincerely,

A handwritten signature in black ink, appearing to read 'Kent Sheldon', written in a cursive style.

Kent Sheldon
Engineering Manager
SMA America